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THE BIOLOGY OF THE BLUE GROUSE  
OF THE SHEEP RIVER AREA

by

David Archibald Boag

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Adult Male Richardson's Grouse Displaying  
(Photographed From Painting By F. Lansdowne)





Thesis

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THE UNIVERSITY OF ALBERTA

THE BIOLOGY OF THE BLUE GROUSE  
OF THE SHEEP RIVER AREA

A DISSERTATION  
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES  
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by

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## ABSTRACT

A study of the blue grouse on the east slopes of the Rocky Mountains in Alberta was conducted over a period of three summers. This grouse is confined to the foothills and mountain slopes possessing semi-open forests. Here it displays a density comparable to that of any upland game bird species on good range. The blue grouse inhabits distinct breeding and wintering grounds. These grouse arrive on the breeding grounds in April whereupon the adult males become territorial and the adult females roam at will through the territories of different males. These grouse are promiscuous in breeding habits. Subsequent to breeding, the females nest, incubate and rear the brood, at which time they are confined to a home range. The adult males return to the wintering grounds with the immature birds early in August and the adult females and juveniles follow early in September. Male and female blue grouse do not breed in significant numbers until they are two years of age. The population is kept in equilibrium through adverse weather conditions and predation. The former decimates the downy chick population while the latter affects the immature grouse largely. Disease and parasitism are of little significance in the population studied. Management of this bird will depend, firstly, on a general education programme for hunters who are ignorant of this bird and, secondly, on habitat improvement and the possible institution of a spring hunting season.



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## I Introduction

The biology of the blue grouse in Alberta, about which virtually nothing was known, is the subject of this paper. A study of this grouse was undertaken at the Alberta Biological Station which is situated at the mouth of Gorge Creek on the Sheep River south and west of Calgary. Observations by the author during the summer of 1954, while employed in fisheries work at the Biological Station, suggested that a profitable study might be conducted on the biology of this little known grouse of the east slopes of the Rocky Mountains in Alberta. As a consequence, a study area was chosen and research was begun in early May of 1955.

The banding of members of a population of animals is now recognized as a valuable technique in securing data on various vital statistics of the population (Leopold, 1948). Banding animals in such a manner that individuals may be recognized in the field adds greatly to the value of data secured through subsequent observations. Therefore, a banding programme was begun in 1955 in which grouse were caught and then tagged. To the right leg of every grouse caught an official U. S. Wildlife Service Aluminum band was attached and to the nape of the neck of each bird a plastic neck tag was secured by means of a safety pin. The one inch by two



inch plastic neck tags were a series of different combinations of laminated blue, yellow and red vinyl plastic. This enabled individuals to be separated in the field. During the first summer's study, 37 grouse were caught by snaring them with a 15 foot bamboo pole on the end of which was a sash cord noose. All these grouse were marked in the above manner. Because the plastic neck tags proved unsatisfactory in that the grouse lost them too easily (presumably the tags pulled out when the birds passed through heavy vegetation) they were not used in 1956 or 1957. In their place colored plastic "ribbon-style" leg bands were used. With four colors a large number of combinations could be achieved and the grouse could be separated as individuals in the field. During the 1956 season, 49 grouse were so banded and 9 banded birds from the previous year were recaptured and retagged. In 1957, 40 grouse were banded and an additional 6 banded birds from 1955 were recaptured and retagged. In all, 126 individual grouse were caught and marked. Many facets of the behaviour of this grouse, the population present on the study area, and the extent of its daily and seasonal movements were learned through this banding technique. Data on other aspects of the biology of the blue grouse were obtained through field observations both off and on the study area and through the



collection of grouse, both juvenile and adult, during the summer seasons.

In order that blue grouse may be wisely managed from an economic, aesthetic and sporting viewpoint, it is essential that its biology be clearly understood. It is hoped that the results of this study, which covered three seasons, will be of help in the future management of this grouse in Alberta.



## II Taxonomy

The blue grouse has been separated into eight different subspecies. These fall into two main groups, namely, the darker coastal group of four subspecies inhabiting the mountains of the Pacific coast and neighboring islands, and a paler inland group of four subspecies inhabiting the mountainous regions east of the Coast Range. Two coastal subspecies and two inland subspecies are found in Canada. These are, from west to east, Dendragapus obscurus sitkensis Swarth of the Queen Charlotte Islands, D. o. fuliginosus (Ridgway) of the west coast of B. C. and Vancouver Island, D. o. pallidus Swarth of south central B. C., and D. o. richardsonii (Douglas) of northern B. C., southern Yukon and the Rocky Mountains (Munro and Cowan, 1947).

The subspecies of blue grouse inhabiting the east slopes of the Rocky Mountains in Alberta is known as Richardson's grouse - Dendragapus obscurus richardsonii (Douglas). The type locality appears in the literature as "Rocky Mountains, latitude 52° N., longitude 115° W.". This is some 90 miles north of the study area.

The average grouse at Gorge Creek fits the description of the type specimen. The grouse there are generally a uniform race morphologically, However,



Richardson's grouse have been collected on the study area which show some of the characteristics of the dusky grouse D. o. obscurus (Say) (type locality - 20 miles north of Colorado Springs, Colorado) . These birds show a fairly distinct terminal gray tail band and are a shade or two paler than the average. It is believed that these birds may represent an infiltration of a few birds from further south which has led to some introgressive hybridization.





Photograph 1. Adult male Richardson's grouse -  
Dorsal view.





Photograph 2. Adult male Richardson's grouse -  
Ventral view.



### III Description of Richardson's Grouse

#### 1. Plumage

Taverner (1914), following Ridgway's color chart (1912), has described the plumage of adult male Richardson's grouse in the following manner:

"Back, interscapulars and body color of rump - Olive brown to fuscus.

Tail - Fuscus black. Tail feathers cut off sharply and squarely at end.

Throat-patch - Body color, soiled creamy white.

Sides of head and spotting of throat-patch - Fuscus.

Breast and underparts - Light mouse grey.

Around neck below throat patch - Between buffy brown and olive brown to clove brown, with sometimes a faint bluish tinge, deepening in front at lower neck to fuscus."

Adult male Richardson's grouse are pictured in Photographs 1 and 2. The female, depicted in Photographs 3 and 4, follows the same general coloration as the male except for considerably paler shades and much more mottling. Both sexes possess a yellow comb. In the male this structure is more evident and is distended, while the bird is displaying, by filling it with blood. Only





Photograph 3. Adult female Richardson's grouse -  
Dorsal view.





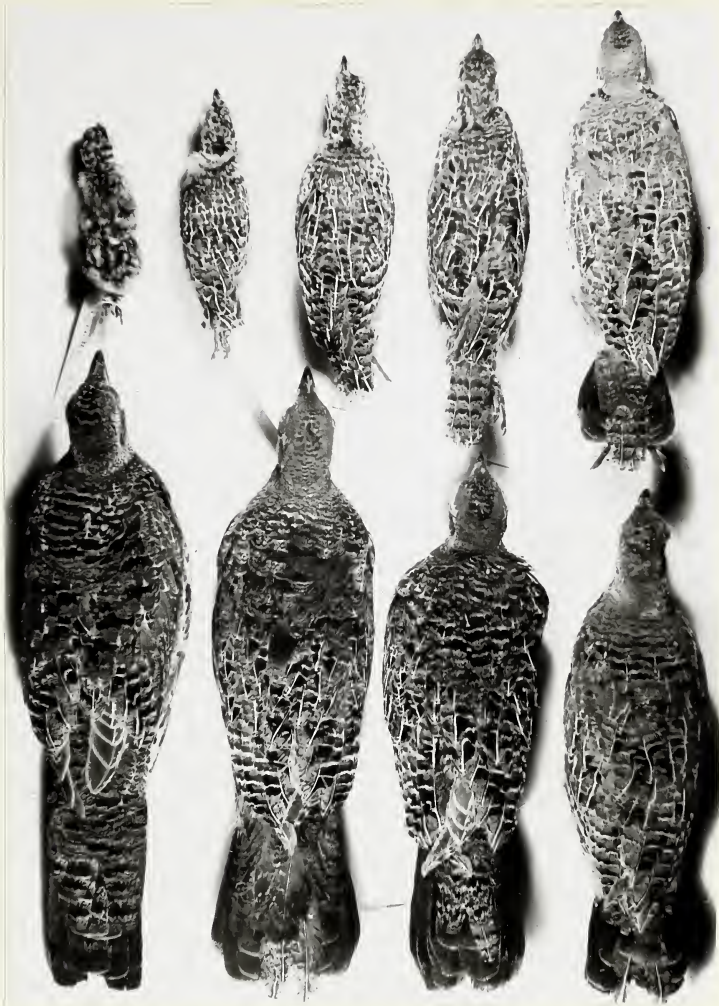
Photograph 4. Adult female Richardson's grouse -  
Ventral view.



the male possesses a distensible gular patch in the region of the apteria on the sides of the neck. Brooks (1928) has described this structure as flesh colored and slightly carunculated. This patch is evident only when the bird is displaying and the neck feathers, which have white bases, are reflexed forming a white rosette around it (Frontispiece). The tail feathers of the male may or may not show a faint grayish terminal tail band, whereas the tail feathers in the female usually show quite a distinct mottled gray terminal band. Unlike those in the male, the two central rectrices in the female are barred for their entire length. As is typical of the North American grouse, Richardson's grouse possess scale-like pectinations on their toes. These scales, which develop late in the fall, are retained throughout the winter but are shed completely by the end of the first week in June.

The downy young of Richardson's grouse resemble the young of other members of the family Tetraonidae (Moffitt, 1938). They are pale, buff-colored chicks liberally marked with darker spots and streaks. The down on these chicks is soon replaced on the breast and back by small, gray-buff feathers, mottled with black and brown. The flight feathers, which are the first to appear, grow rapidly. At about





Photograph 5. Juvenile Richardson's grouse ranging  
in age from one day to thirteen weeks -  
Dorsal view.





Photograph 6. Juvenile Richardson's grouse ranging  
in age from one day to thirteen weeks -  
Ventral view.



seven days the chick is capable of short and wobbly flights. At the age of three weeks the youngsters begin to shed these chick primaries and rectrices. The latter are short, acuminate and barred with black, white and buff for their entire length and are in contrast with the solid black rectrices which replace them. The chick primaries are lost from the carpo-metacarpus in proximal-distal succession; the rectrices are lost in order from the lateral border to the center of the tail. When about a month and a half old the young of Richardson's grouse undergo a post-juvenile body moult and acquire the plumage of the immature birds which is retained until the second summer. This plumage resembles that of the adults except for significant differences in the flight feathers; the immature birds acquire only eight adult primaries during their first summer and retain the ninth and tenth chick primaries which are mottled and acuminate at the tips. They carry these until the middle of September of the following year and because of this can be distinguished from adult birds, i.e., birds over two years of age whose ninth and tenth primaries are not mottled and which are rounded at the tips. A full complement of immature rectrices is acquired during the post-juvenile moult and these feathers are fully grown before the broods migrate to the





Photograph 7. Rectrices from Richardson's grouse

- a. Adult female
- b. Immature female
- c. Adult male
- d. Immature male



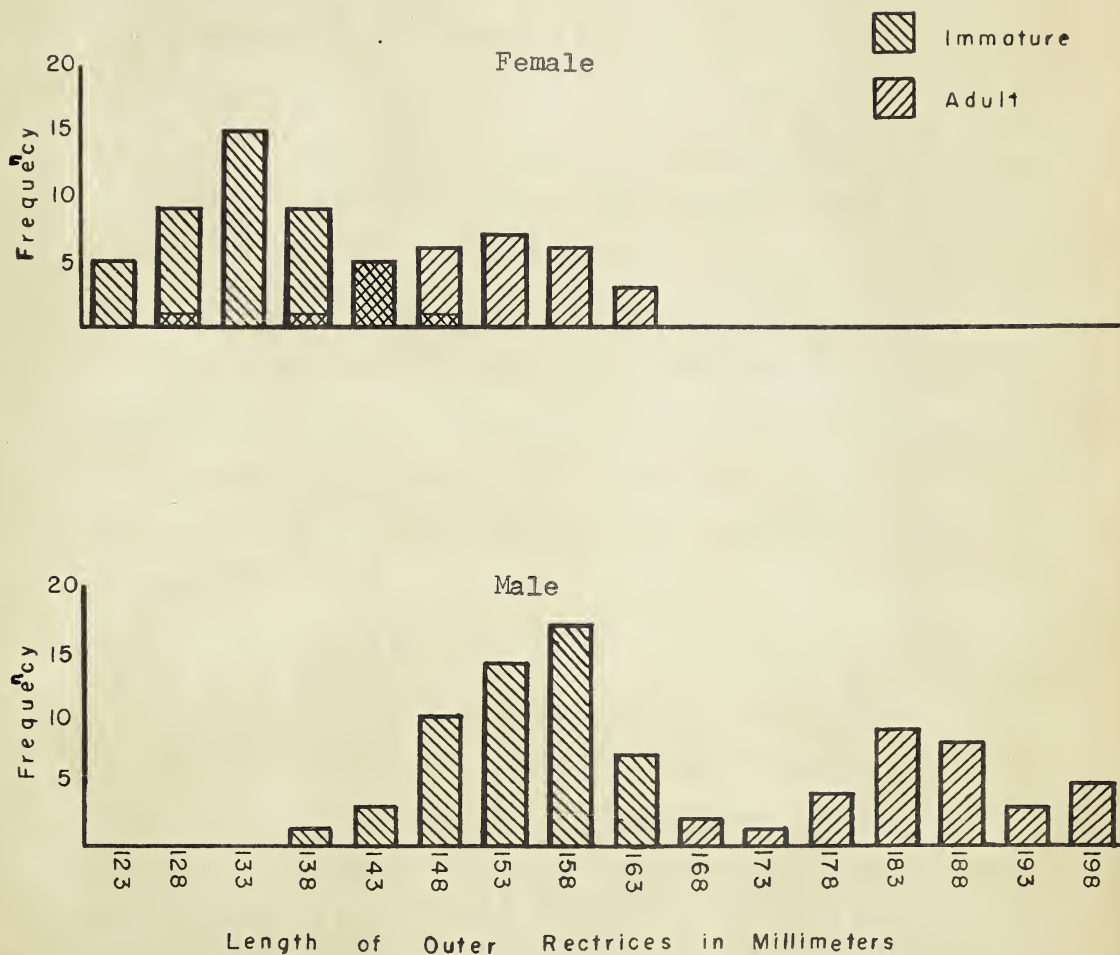
wintering grounds. The plumage sequence in juvenile Richardson's grouse is pictured in Photographs 5 and 6. Figure 1 indicates the difference in the length of rectrices of immature and adult Richardson's grouse (Photograph 7). This graph is based on the measurements of the two outer rectrices from 157 grouse.

From Figure 1 it is evident that any grouse possessing outer tail feathers over 165 mm. in length is an adult male bird; also any female possessing outer tail feathers more than 150 mm. in length is an adult bird. Immature rectrices, besides being shorter, are also narrower than those of adult birds.

In females there is a considerable overlap in lengths of rectrices of immature and adult birds. If the rectrices of a female fall into this category, then the age could be checked by use of the primaries, that is, immature birds would still retain the ninth and tenth juvenile primaries which are considerably more acuminate at the tips than those of the adult. Van Rossem (1925), in referring to the immature rectrices, says "most of these rectrices are replaced during the following winter, spring and summer, but some (usually the outer pair) are apparently retained until the following fall". The study at Gorge Creek showed no evidence of any



Figure 1. Comparative Length of Rectrices  
in Adult and Immature Richardson's  
Grouse





such gradual loss, but rather, the full complement of rectrices was retained until the first of August of the bird's second summer, whereupon the immature bird underwent a complete body moult including rectrices which were all replaced again by the middle of September. The two juvenile primaries of the immature bird are lost in September of its second year. This is the culmination of the first complete moult into adult plumage. At this time according to Buss et al. (1954) the bursa of Fabricius closes. The adult birds undergo a post-nuptial moult on the breeding grounds. The males leave the breeding grounds before the rectrices are shed, but after all but the three outer primaries are moulted. At this time the males have also undergone a partial body moult. As in the chicks, the flight feathers of adults and immatures are moulted in order from proximal to distal on the carpo-metacarpus and from lateral to mesial in the tail. The post-nuptial moult of the female is later than that of the male. The latter commences to moult about the first of June whereas the former does not begin to moult until after the chicks have hatched, i.e., the first of July. The adult female leaves the breeding grounds having undergone a partial body moult; a variable number of rectrices and all but two primaries have been replaced. Both adult male and female complete their post-nuptial moult on the wintering grounds.



## 2. Morphology

Richardson's grouse is one of North America's largest grouse being surpassed in weight only by the sage grouse, Centrocercus urophasianus (Bonaparte). Table I gives the weight in ounces of adult and immature birds taken on the breeding grounds at Gorge Creek, May to August inclusive.

Table I Weight in ounces of adult and immature Richardson's grouse taken at Gorge Creek.

<u>Age</u>	<u>Sex</u>	<u>Number</u>	<u>Range in weight</u>	<u>Average</u>
Adult	Male	43	38.5 - 49.5	43.0
	Female	65	26.0 - 44.0	32.9
Immature	Male	11	30.0 - 40.0	35.0
	Female	30	26.0 - 37.0	30.0

The table gives an average weight for adult female grouse which is too low. This is due to the fact that a large proportion of the females were weighed at the end of the incubation period. As will be seen in a subsequent section on growth, the female loses up to one third of her body weight while incubating. From Table I it can be seen that immature birds must still be growing during their second summer. They do not reach maturity within 119 days as Wing et al. (19<sup>44</sup>) surmised by extrapolation.



Table II presents measurements from skins of Richardson's grouse collected in the Gorge Creek area.

Table II The standard measurements, in millimeters, of 15 adult Richardson's grouse.

<u>Sex</u>	<u>Number</u>	<u>Wing</u>		<u>Tail</u>		<u>Culmen</u> ★	
		<u>Range</u>	<u>Average</u>	<u>Range</u>	<u>Average</u>	<u>Range</u>	<u>Average</u>
Male	11	218-231	225	157-177	168	28-31.5	28.8
Female	4	196-211	203	134-147	141	28-30	28.5

★ The chord distance, in the midline, from the tip of the upper mandible to the posterior edge of the horny sheath.



## IV Distribution

### 1. General Distribution In Alberta

Richardson's grouse is confined to the mountainous regions of the west. Beer (1943) has noted that this grouse closely follows the distribution of the Douglas and alpine fir, when these conifers are found in mountainous terrain. In Alberta, Richardson's grouse is confined to the east slopes of the Rocky Mountains and the neighboring foothills. They range from the headwaters of the Smokey River in the north, south to the international border and on into Montana, east as far as the lower foothills, and west into British Columbia. Within this area the requirements of terrain and vegetation are met.

### 2. Distribution And Population Density

#### On The Study Area

The study area of approximately seven hundred and twenty acres at Gorge Creek has an altitude of 4700 to 6000 feet above sea level. Four main vegetation complexes are represented: These are stands of trembling aspen (Populus tremuloides), mainly in small clumps at the lower elevations; open grassy areas surrounding the clumps of aspen; mixed stands



MISSING LINK MOUNTAIN

STUDY AREA

Biological  
Station

Gorge Canyon





of aspen and fir (Pseudotsuga taxifolia) and spruce (Picea glauca) at intermediate elevations; and lodgepole pine (Pinus contorta) at the highest elevation. Figure 2 presents an aerial view of the study area.

Richardson's grouse showed a great preference for areas where the foliage of the trees sheltered only 50 to 75 percent of the ground. Through the use of a planimeter on an aerial photograph of the study area it was found that only 530 out of the 720 acres afforded suitable cover. The remaining 190 acres were open grassy hillsides and flats on which grouse were never seen and which, presumably, were not utilized. The birds were seldom found more than 100 yards from trees and hence were confined to the tree-covered parts of the study area.

Lagler (1949) gives a formula, which is a modification of Schnabel's (1938), for estimating the population of fish in a lake. It is based on the marking of members of a population and the ratio of marked to unmarked fish recaptured later. It was felt that this same formula could be used to estimate the number of grouse present on the study area by recording the number of marked and unmarked grouse seen through daily observations. The formula is as follows:



$$P = \frac{\sum AB}{\sum C}$$

where A = number of grouse seen on any date

B = number of marked grouse present on  
the study area on any date

C = number of marked grouse seen on any date

P = the estimated population on any date.

Tables XVI, XVII and XVIII show the application of the formula and the estimated population of adult and immature birds on the study area for May and June of 1955, 1956 and 1957. It will be noted that the tables give a stable value of P only after a considerable number of observations are made, i.e., P is only reliable when it no longer continues to rise with increased values of A, B and C. The values of P show a <sup>drop</sup> off from 1955 to 1957. This decrease in population density is correlated with a general decline in numbers of grouse seen in over-all observations both on and off the study area during the three summers. The population density is summarized for the three study years in Table III.



Table III Density of Richardson's grouse  
on the study area at Gorge Creek.

<u>Year</u>	<u>Total Study Area, Acres / Bird</u>	<u>Habitable Area, Acres / Bird</u>
1955	6.1	4.5
1956	9.0	6.6
1957	9.9	7.3

From Table III it is evident that the density of breeding grouse in the Gorge Creek area, over the three summers, compares favorably with other species of the Tetraonidae on good range (Leopold, 1948).



## V Reproduction And Family Groups

### 1. The Breeding Grounds

The study of Richardson's grouse was begun during the first week in May of the years 1955 to 1957. By this time a population of grouse was already present on the study area. However, during a two-day visit to the study area on March 24 and 25 in 1956 no birds were seen and no evidence of birds was found. Residents of the area report that birds are rarely seen in winter and then only at higher altitudes. It was concluded, therefore, that no birds had as yet returned to the breeding grounds by the last week in March. Hence the main population of grouse must arrive on the study area in April. On May 9 and 18 of 1955, grouse were seen gliding at a considerable height towards the slopes of Missing Link Mountain which form part of the study area. It was presumed that these birds had come from the ridges to the south and west and were late arrivals to the breeding grounds. This occurrence is similar to the description of the spring migration of Richardson's grouse in Oregon (Anthony, 1903). He describes the birds as walking to the highest point of land on their winter range from whence they glide out over the intervening valley and alight on the opposite slope up which they



walk and thence to the next slope and so on until they reach the breeding grounds.

Hoffman (1956) and Wing et al. (1944) report that there is no obvious development of territorialism in the eastern race of this grouse. Bendell (1955), on the other hand, reports that territorialism is highly developed in the western race. The findings at Forge Creek do not agree with the former authors, and indicate that territoriality is highly developed in the eastern form, at least north of the 49th parallel. Table IV presents the pertinent evidence.

Table IV Sight records during 1955, 1956 and 1957  
of five adult male Richardson's grouse  
(May to August)

Official tag Number	Number of times seen			
	a. at site of tagging	b. 1/16 mi. from a.	c. 1/3 mi. from a.	d. 3/16 mi. from a.
526-92402	8	3	1	0
526-92405	6	4	2	0
526-89905	4	5	1	0
526-89906	2	7	1	1
526-92425	11	1	0	0
% of total	54	35	9	2

From these data, the following facts can be deduced: First, the territory of the adult male grouse



seldom exceeds an area of  $1/8$  mile in radius; second, the adult male grouse is confined to his own territory for the duration of his stay on the breeding grounds. Further evidence of territoriality was obtained through numerous observations made while attempting to snare and mark hooting male grouse. The birds, when forced to the edge of their territory, would try to double-back past the snarer and so remain within their territorial limits; however, if this was prevented the bird would usually flush and land in a tree on a neighboring territory; there it would remain silently until the invader had retired, whereupon it would fly back to its territory and resume hooting or courting.

Once a territory is established by a male grouse, it is reoccupied during each succeeding breeding season, presumably for the duration of that bird's life. Bendell (1955) found this to be true of the highly territorial sooty grouse of the west coast. Table V presents the evidence of males returning to their territories.

It is seen from Table V that five out of eight birds banded in 1955 held the identical territories on the two following years. The case of number 526-92425 is different in that this bird was not seen on the study area in 1956 but returned to his territory of two year's previous in 1957. The



Table V    Record of adult male grouse  
seen on their territories.

<u>Tag Number</u>	<u>Number of times on territory after banding</u> ☆		
	<u>1955</u>	<u>1956</u>	<u>1957</u>
Banded in 1955			
526-92419	1	1	1
526-92402	4	4	4
526-92417	2	-	-
526-92405	-	10	3
526-92412	-	5	10
526-92425	-	-	12
526-92422	-	-	-
526-92416	-	6	4
Banded in 1956			
526-89906		3	8
526-89905		3	7
526-89919		1	5
526-89923		-	-
526-89908		2	-
526-89932		-	1
526-89909		-	-

☆ No banded adult male grouse were seen other than  
on their own territories.



remaining two birds may have died or, like number 526-92425, were away from the territory for a two year period for unknown reasons. In 1957 four of seven cock birds returned to their territories of the year before. One of the remaining three birds was shot in 1956, the fate of the other two is unknown. It can be concluded from these data, that territories, once established, are reoccupied year after year.

Territories are only held by mature male birds, i.e., birds of two years and older. At no time during this study was a yearling male found holding a territory or showing any of the aggressive tendencies characteristic of the male occupying a territory.

Territory size varies with the terrain and cover. It was observed that the concentration of breeding males was greatest in open pine, i.e., areas where the lodgepole pine trees sheltered approximately 50 percent of the ground surface. Consequently in these areas the territories occupied were relatively smaller than those on the lower slopes which were covered mainly by poplar groves. A rough estimate of the size of a territory in open pine was an area 100 yards in diameter, whereas in the poplar groves each male grouse occupied a territory in the neighborhood of 400 yards in diameter. Territorial birds in mixed stands occupied territories of magnitude between the



above two extremes. It should be emphasized at this point, however, that the vegetation itself was less important than the relative amount of shelter. It was found that though male grouse seemed to be most concentrated on areas of open pine, they were absent entirely from areas where pine created 100 percent coverage of the ground area. Their numbers decreased from a maximum at about 50 percent coverage to a minimum at 100 percent coverage. They also decreased as the amount of tree cover declined below 50 percent; and no grouse occurred in areas of less than about 15 percent coverage. These estimates are based on the lodgepole pine stands, but similar estimates apply to other vegetative types, except that in poplar groves, the maximum numbers were found where the coverage was approximately 75 percent. From these data the importance of plant succession in the ecology of the breeding blue grouse may be deduced. Interspersion of vegetation types creates the most highly preferred habitat.

The female grouse, on the other hand, is not territorial but exhibits a home range which varies from 1/2 mile to 3/4 mile in diameter. This range seems to lack precise boundaries and is not defended. On many occasions two or more females with broods were found in close proximity and one may



surmise either that their respective home ranges overlapped one another or that they lacked precise home ranges. Food and cover seem to play the major role in choice of home range. This point will be established in the succeeding sections. In Table VI the shift in home range of female number 526-89925 from the area of 1956 to that of 1957 is shown. In 1956 this female and her brood covered a range  $3/4$  miles in diameter and in 1957 a range of the same magnitude but in a different location.

Table VI Range of female number 526-89925  
and her brood of 1956 and 1957.

Year	Number of times seen			
	a. at site of tagging	b. $1/4$ mi. from a.	c. $1/2$ mi. from a.	d. $3/4$ mi. from a.
1956	-	-	-	2
1957	1	9	1	2
	e. 1 mi. from a.	f. $1\ 1/4$ mi. from a.	g. $1\ 1/2$ mi. from a.	
1956	3	3	2	
1957	-	-	-	

That females return to the same breeding grounds year after year is also true, but along with their lesser developed territorial tendencies so is there less tendency to return to the same breeding grounds. It may be seen from the data in Table VII



that the return of females to the breeding grounds is significantly lower than that of the males.

Table VIII is a summary based on the returns of grouse to the breeding grounds, cited in Tables V and VII.

Table VIII Return of grouse to breeding grounds, males and females banded as adults.

		Percentage return	
		<u>1 yr. after banding</u>	<u>2 yr. after banding</u>
Male	1955	63	75
	1956	57	-
Female	1955	13	13
	1956	43	-

The difference in returns observed in Table VIII may be due to the tendency of females to wander more or it may be due to a weaker homing instinct. The reason may lie also in their higher susceptibility to predation. The results of a study of the food habits of the golden eagle on the study area during the summer of 1955 suggest this conclusion. During occupation of their nest, the eagles took 10 grouse, of which the sex of 8 was discernable. Five of the eight were females and three were males. This is not statistically significant considering the few birds taken but it is suggestive.



Table VII Record of banded adult female grouse  
seen on the study area.

<u>Tag Number</u>	<u>Number of times seen on breeding grounds</u>		
	<u>1955</u>	<u>1956</u>	<u>1957</u>
Banded in 1955			
526-92407	3	-	-
526-92421	2	-	-
526-92406	1	-	-
526-92401	3	-	-
526-92418	8	-	-
526-92410	1	-	-
526-92414	2	1	1
526-92430	1	-	-
Banded in 1956			
526-89903		1	-
526-89907		5	-
526-89910		1	1
526-89911		5	1
526-89912		3	3
526-89913		1	-
526-89918		1	-
526-89926		1	4
526-89924		4	2
526-89927		3	-
526-89929		2	-
526-89925		10	14
526-89928		2	3



Table VII - cont'd.

<u>Tag Number</u>	<u>Number of times seen on breeding grounds</u>		
	<u>1955</u>	<u>1956</u>	<u>1957</u>
526-89923		1	-
526-89934		2	1
526-89936		2	-
526-89931		1	-
526-89935		4	-
526-89938		1	-
526-89939		5	1
526-89937		7	-



Territory and home range are forsaken when the birds leave the breeding grounds. All adult males had left the breeding grounds by August 14, 1955, August 5, 1956 and August 12, 1957. Females and broods were still on the study area on September 15, 1955, September 13, 1956 but had departed from the study area by September 5, 1957.

## 2. Behaviour Of Breeding Birds

Male Richardson's grouse have a behaviour characteristic of all territorial birds. They have a focal point in their territory, usually under a tree, from whence they move out in all directions. They are pugnacious and challenge any intruder, including man. They are excitable and are stimulated to courtship display by a female present on their territory. They emit challenges vocally by a series of hoots or non-vocally by a flutter of wings. Howard (1920) states that these are inherent mechanisms that precede a successful completion of reproduction.

As has been previously stated, territorial behaviour is confined to birds two years of age and older. Brooks (1926) reported that Richardson's grouse displays only from the ground, a fact born out in this study. Most displaying is done at the focal point of the bird's territory; here the



grouse performs his various antics, in an effort to stimulate the female into receptivity. When the light intensity is low, the cock bird will venture away from the sheltered focal point of his territory and hoot and display in the open. Bendell (1955) found that maximum courting activity occurred when the light intensity registered two to four foot candles.

Display in Richardson's grouse involves a spreading of the fan-like tail which is held at an angle over the birds back. The wings are drooped slightly and the neck feathers fluffed out. The feathers surrounding the gular patches are reflexed and form a rosette of white around the reddish-purple skin. In display the gular patch is slightly distended by being surcharged with blood; the combs also are distended and become orange instead of their normal yellow color. In this posture the cock bird will approach a female in a series of tacks, showing first one side then the other. When hooting, the tail is dropped somewhat and the neck feathers fall back into place leaving only a white line at the side of the neck. The spring call was described by Brooks (1925) as a series of "five, rarely six, deliberate evenly-spaced hoots or grunts - Humph-humph-humph-ma-humph-humph". A second call is often heard at the height of the



breeding season and is a single loud hoot not unlike the sound produced by withdrawing a cork from a bottle. This single hoot can be heard for considerable distances - up to two miles if the atmospheric conditions are right, and thus differs markedly from the gentle hooting which is barely audible at 75 yards. The cock birds emit this single call only when in the presence of a female. It is voiced after a short run at the female. Observations suggest that if the female is receptive and squats when approached by the male coition results; however, if she is not receptive then she dodges aside and the male emits a loud "bloop" followed by a shrill whistle (the latter only audible at <50 feet).

Wing (1946) described the drumming flight of blue grouse. This is done only by the cock grouse and is a short flutter into the air. It involves a leap into the air and a rapid fluttering of the wings while the bird planes down to the ground in an arc. Wing (op. cit.) states that a female taking wing stimulates a cock bird to "flutter"; however, this study has shown that the "fluttering" does not necessarily involve stimulation by the hen. It was found that cock birds would "flutter" periodically out of what appeared to be sheer exuberance. They were also stimulated by other male birds flushing or "fluttering".



Female Richardson's grouse arrive on the breeding grounds with the males. This study has shown that only female birds of two years and older breed. These mature females are not territorial but rather wander through the territories of courting males and mate with the male that is closest when they are receptive. Richardson's grouse can thus be termed promiscuous in breeding habits.

### 3. Nesting And Incubation

During the three summers' investigations, twenty-five nests were found; all of these were built on a slope, usually quite steep. Most nests were located so as to have a south-west-facing aspect, where sparser vegetation and open grassy slopes allowed the bird to spring from its nest, if molested, and glide unimpeded down the slope. No nests were found on the heavily treed northern slopes where such escape would be difficult. The favourite site seemed to be under an overhanging rock or shrub. Forty-four percent of all nests were found under rocks and forty-four percent under shrubs. The remaining 12 percent were under logs or overturned stumps. In all these situations the incubating bird is sheltered from the rear and from above, and hence is fairly invulnerable to attack by predators, (Neilson, 1926). No nests were



found completely in the open. However, there is a preference for nest sites in the semi-open, i.e., with no trees or shrubs closer than ten yards. Here 66 percent were found. The remaining 34 percent were placed under trees - usually sparse and mature. Most of the nests found were within easy access of open water.

The nest itself is a simple depression in the ground lined with whatever material is near at hand - usually dry grass, pine needles or dead leaves. A few feathers from the incubating bird are added. The eggs are partially covered when the bird is not on the nest.

Fifteen of the 25 nests contained eggs or egg remains from which it was possible to determine the clutch size. The clutches ranged from five to nine eggs with an average of seven.

Breeding female grouse commence nesting on the study area from about May 21 to June 1. It was found that in 1955 and 1956 they did not commence until the latter date, whereas in 1957, when spring came earlier, they began about May 21. These dates correspond well with those of Dendragapus o. obscurus in Colorado and Wyoming (Bendire, 1892). In 1956 a nest was discovered on June 3 which contained only two eggs. On June 5 when next observed, it contained three eggs. On June 6 it still contained three eggs. On



June 8 the female bird was seen on the nest at 10:30 a.m. and again at 8:30 p.m. - she was not flushed from the nest. Finally, on June 9, the bird was still on the nest and when flushed revealed five eggs. Unfortunately, the bird deserted at this point and it is not known whether or not this was a full clutch. From these observations, it is reasonable to assume that the eggs are deposited at the rate of about one in slightly less than two days. Therefore it would require about 11 to 12 days to lay an average clutch of seven eggs.

The incubation period is about 23 days. This is based on a nest found in 1955 in which the female commenced incubation on June 3 and the eggs were pipped on the morning of June 26. This incubation period agrees with those of other members of the Tetraonidae (Leopold, 1948). With an incubation period of approximately three weeks, hatching occurs near the end of June and beginning of July.

Of the 15 nests in which eggs were found, 26 percent were lost either through desertion or predation. However, this percentage does not reflect a true picture of egg losses because the desertions were caused by man and the number of nests observed was too few to form a basis for firm conclusions.



#### 4. Rearing The Brood

Typical of all nidifugous species, the precocious chicks of this grouse leave the nest with the female as soon as their down is dry. The brood remains near the nest for the first few days and may return to it to roost; the latter fact was established in 1957 when a nest from which grouse had recently hatched was found to contain numerous chick faeces. Until the chicks are able to fly they remain close to the female and range but short distances from her. At this stage they are most often found on open grassy slopes which are always relatively drier than the treed areas, and hence more attractive to the adult female and better for the downy young which are susceptible to pneumonia when wet and cold. On these open slopes, which show a good growth of grass by the second week in July, the chicks find adequate insect food which forms their main diet at this age. Besides feeding in these areas, they also roost in them, probably because they can easily scatter if disturbed at night. An example of this behaviour was observed on July 10, 1956, when a female was flushed off her chicks; she fluttered about, clucking and whining, and the chicks all soared unsteadily down the slope in different directions. If danger threatens during the day, the female slowly sinks low to the ground



and utters an almost inaudible purr which warns the chicks. The chicks then become motionless and hide in tufts of grass or other cover. In this attitude the whole family trusts to their protective coloration in avoiding observation. When forced to flush, the female bursts forth uttering a plaintive wailing sound and performs a very convincing "broken-wing" act. The chicks remain immobile and even allow themselves to be touched before they will move.

The cock birds, which play no part in the rearing of the broods, are nevertheless stimulated to renew courtship antics when the females appear with their young. They court with all the accompanying hoots, posturing and "bloops" which marked the climax of courtship prior to nesting. The female and her brood show no interest in these antics and soon move to an area where the males do not molest them.

As the chicks mature they wander farther from their mother but always keep in contact with her by uttering low whines which she acknowledges by soft clucks. Now they are more often in treed areas or in rank vegetation, for when the chicks are feathered, the wet herbage no longer has such detrimental effects. Here also it is cooler during the heat of summer days. With the coming of fall the female leaves the breeding grounds and begins a slow trek towards the winter range. She is accompanied by her brood.



## 5. Behaviour Of Family Groups

Blue grouse are capable of producing a variety of sounds. Those of the breeding male have been described and the communicating vocalizations between the hen and her chicks have been discussed. Wing et al. (1944) mentioned a "wailing cry of lost chicks". This occurs whenever a chick loses sight of its mother and increases in intensity until there is either a warning purr from the female which silences the chick or an acknowledging cluck which brings the chick to the old bird. These same authors state that the "brood instinct is rather low in blues"; however, the study at Gorge creek contradicts this statement as it was found that brood instinct was very high. To illustrate, on September 12, 1955, a brood was found and a chick was separated from the other members of the family group in an attempt to snare it. Once separated from the group, the nearly full grown chick showed great agitation by whining loudly and running to and fro trying to bypass the snare and return to the brood; so great was its concern that it ran between the legs of the person attempting to snare it. All the while the female showed anxiety by clucking. When again united with the brood the chick became serene and the whole family moved off together in a tight group.



Unlike the chicks of ruffed grouse, which flush emitting, as<sup>a</sup> rule, a rather loud whistling cry, blue grouse chicks flush one after another and, usually, are silent or emit a softer cheep. When flushed, blue grouse will invariably fly downhill if this is possible, or if not, will flutter up into nearby trees where they sit motionless, relying on their immobility and protective coloration to avoid detection. The chicks commence flying when about seven days of age. The first flights are short and wobbly and the birds lack the skill of slowing themselves when ready to alight in a tree after having glided down a slope. By the time the chicks are three weeks old they are strong on the wing and capable of prolonged flight. Wing et al. (1944) mention the reshuffling of broods and the combination of two or more broods. Never was this noted in the study at Gorge Creek. Evidence to the contrary is presented in Table IX.

The data in Table IX show that after the chicks are three weeks of age (at which time the brood counts are reliable because all chicks can be forced to flush) the brood remains constant or decreases. This eliminates the possibility of shuffling of chicks between broods. These data are also substantiated by the known history, in 1957, of the brood of female



Table IX Number of chicks per brood as observed for five female blue grouse during the period June 22 to August 30.

Tag Number	Number of chicks seen per brood									
	June 22-28	June 29-5	July 6-12	July 13-19	July 20-26	July 27-2	Aug. 3-9	Aug. 10-16	Aug. 17-23	Aug. 24-30
526-89925	2			7		7	7	7	6	6
526-89940	1	8	7	7	7					
526-89913				5	2				2	2
526-89927		4							4	2
526-89935					1			1	1	1



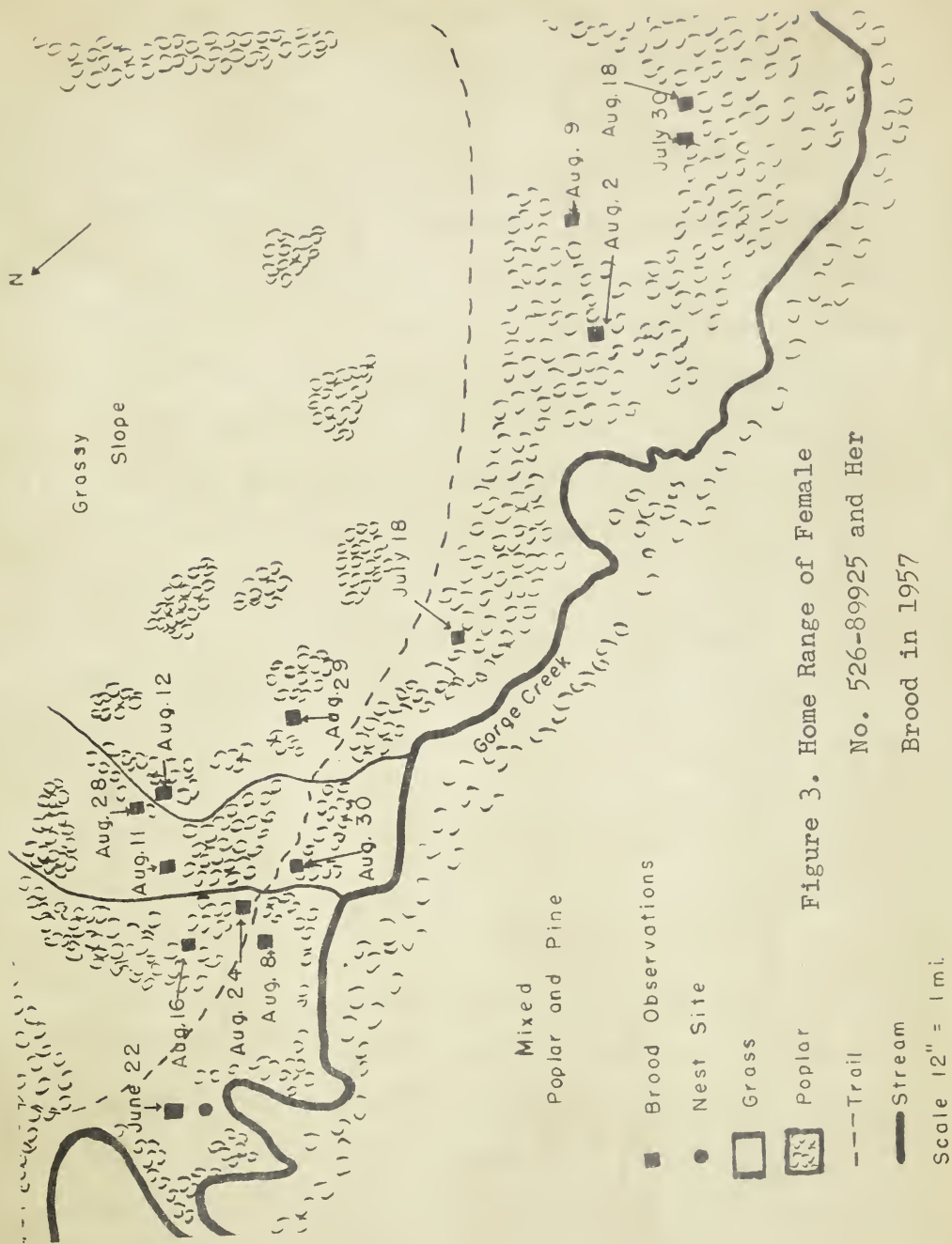


Figure 3. Home Range of Female  
No. 526-89925 and Her  
Brood in 1957



number 526-89925. This bird, found incubating eight eggs, hatched all successfully. When a day old, one chick was collected for scientific purposes (only two were seen at the time). All the remaining chicks were subsequently located and tagged and therefore, could be positively identified during the rest of the season. On August 18 another chick from this brood was collected which reduced the number to six. The brood was last seen on August 30 at which time it was still intact. At no time were extra chicks seen with them despite the fact that they shared the range with at least one other brood.

Each brood of blue grouse tended to inhabit a discrete territory. This is probably not a 'territory' in the same sense as that of the male bird. It is more correctly termed a home range which is determined primarily by the nest site and by the available food supply and cover. The cruising radius within this home range varies, but usually is not more than one-half mile per day. Fourteen sight records of female number 526-89925 and her brood, in 1957, have been used to prepare Figure 3. The figure illustrates the home range of this bird and reveals that it was fairly well-defined. It also illustrates their preference for semi-open slopes of poplar groves and grassy areas.

The broods occupy their home ranges



during July and August; then they move off the breeding grounds as a group and begin the movement to wintering grounds. This migration presumably takes the birds over a distance of at least eight miles. This is only an assumption because no banded birds have been recovered more than two miles from the breeding grounds at Gorge Creek and the nearest known wintering grounds are about eight miles distant. These particular wintering grounds lie in a south-westerly direction from Gorge Creek and are at about the 7000 foot level, i.e., at timberline on Junction Mountain. Two banded birds were collected in September south-west of the breeding grounds and were presumed to be migrating. The first, an adult, female number 526-92421, was shot on September 1, 1955, at a distance of one and one quarter miles south-west of the point at which she was banded. The second, adult female number 526-89942, was shot on September 5, 1957, two miles south-west of the point at which she was banded. These two records suggest that the birds from the Gorge Creek breeding grounds migrate south-west to the nearest known wintering grounds on Junction Mountain. Both the above females were accompanied by a brood of fully-fledged chicks as was the case with several unbanded females. It is reasonable to assume therefore that these grouse perform the migration as a family group at least until the first



height of land is reached. The movements from these heights of land are unknown. The two banded birds collected and on which the assumptions as to movements were based were both adults. The juveniles may perform quite different migrations; on October 19, 1957, a banded juvenile female was shot on the Jumping Pound River, which lies 27 miles to the north of the point where the bird was banded. This is probably an example of dispersion through population pressure, which affects juvenile birds but not adults which have become established on breeding and winter ranges. This first step in the migration is assumed to occur on foot "in response to a geotropism", (Wing, 1944). Anthony (1903) speaks of the fall migration of Richardson's grouse as being a much more gradual affair than the spring migration but possessing the same principles of walking to the top of a ridge and then soaring across the intervening valley to the slope of the next ridge until the wintering range is reached. The seasonal cruising radius is presently assumed to be approximately eight miles.

#### 6. Break-up Of Family Groups

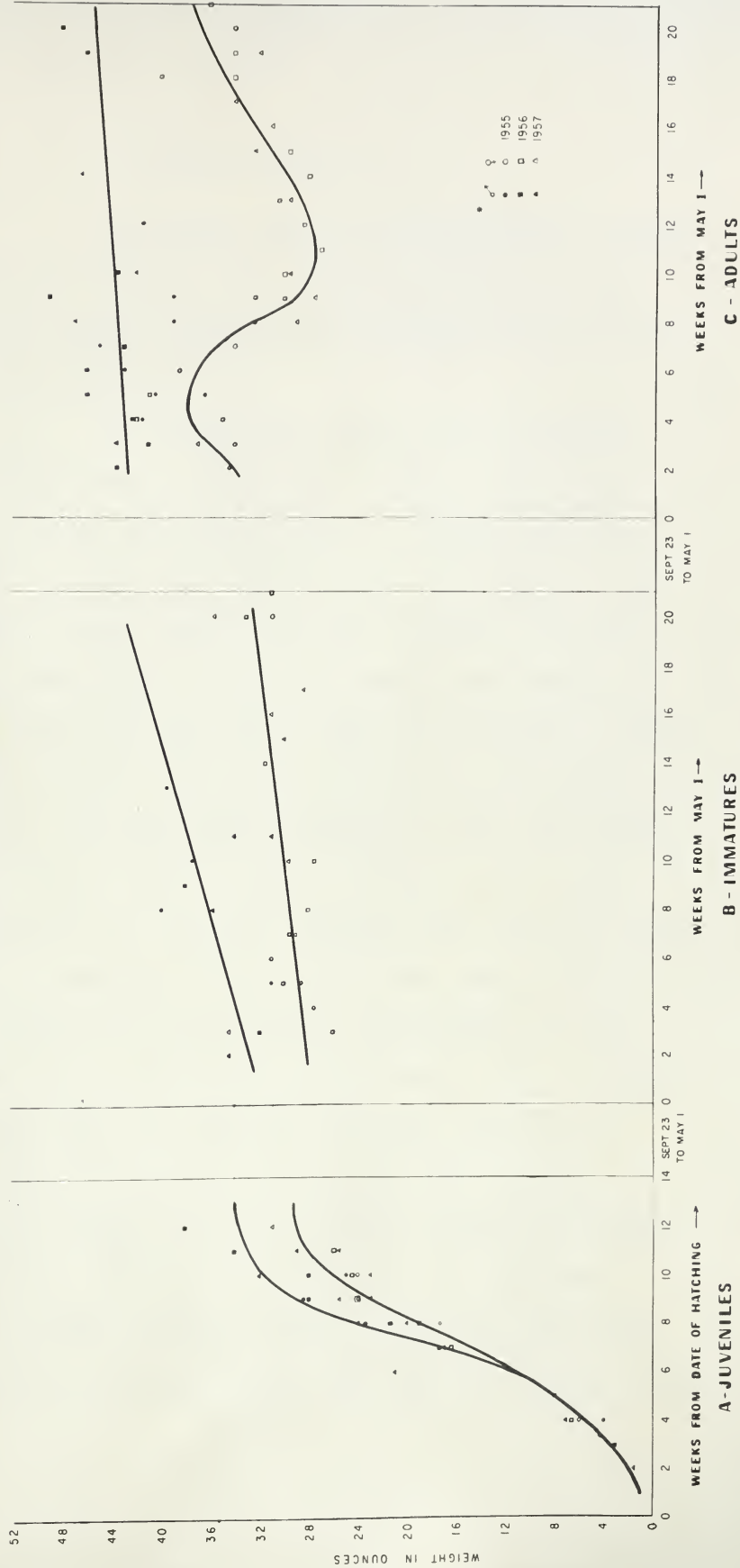
The study at Gorge Creek indicated that the family groups break up on their way to the wintering grounds. In the preceding section it was noted that



the adult females and their broods left the breeding grounds together and proceeded as a group at least until the first ridge was reached. This first ridge south-west of the breeding grounds is known as Mount Hoffman. On numerous occasions adult females and their broods were flushed from the north-east slopes of this ridge, up which they were presumably walking. On September 8 and again on September 12, 1957, juvenile grouse were collected from the top of Mount Hoffman. These birds were solitary and presumably had not yet ventured across the intervening valley to the next ridge where it was assumed that the remainder of the brood had gone. Further data were secured from observations of grouse on the wintering grounds in September. On the morning of September 7, 1955, 41 grouse were flushed from the open slopes above timber line on Junction Mountain. These included 17 adult males, 8 adult females, 9 juveniles, and 7 birds of unknown sex and age. The juveniles were in groups of threes, and in one case were in the company of an adult male and two females. The remaining two groups were without adult birds. A similar situation was noted again in 1957. Therefore, it is reasonable to assume that the family group breaks up enroute to the wintering grounds. There may be partial or complete reunion of families again on the wintering grounds, but the observations that have been made suggest otherwise.



Figure 4. Weights of Juvenile, Immature, and  
Adult Richardson's Grouse.



★ Each point represents the average weight for all birds weighed during the given week in each year



## VI Growth Rates

The growth data for Richardson's grouse are shown in Figure 4. The figure is based on the weights of grouse which appear in Tables XIX, XX, and XXI of the appendix.

The young blue grouse show a typical growth curve during their first summer. The growth rates of males and females begin to differ when the birds reach about six weeks of age. From then on the males gain weight faster than the females. By their first autumn, males average 32 ounces and females 28 ounces. From the curve it is seen that weight is maintained throughout the winter. During the following summer the immature birds continue to gain and reach mature weights in the autumn of their second year. As was noted in a previous section, the complete adult plumage is acquired at this time with the moulting of the ninth and tenth juvenile primaries. As well as being below adult weight until their second autumn, the grouse are also sexually immature. During the three summers study of this grouse, nine immature males were marked; not one of these birds was holding a territory, hence none of them may be considered sexually mature. Bendell (1955) found the same thing true of the west coast race, that is they did not hold



a territory until two years of age. However, in the same paper Bendell states that 70 percent of the immature females of the coast race breed during their second summer. This was not the case at Gorge Creek. Here it was found that out of 23 immature females examined and marked, only one bird had bred during her second summer, which is only four percent of the total immature females. Breeding females were characterized by the possession of a brood patch or else showed agitation typical of birds with broods. This difference in percentage of breeding females may be due to the relatively shorter season at Gorge Creek and the fact that the grouse are not as well developed physically when overtaken by winter conditions as they are on Vancouver Island. The weight reached at the end of the second summer is again maintained throughout the winter. With spring the females become gravid and their average weight increases and then falls off sharply during incubation; it continues to drop slowly for two weeks after hatching. The lost weight is regained by September. The adult males show no significant weight change over the breeding season, but do show a slight gain towards autumn.



## VII Food And Feeding Habits

The results of an analysis of the contents of 38 crops of adult and immature birds taken during the period May to September, inclusive, are presented in table X. Seventy four percent of these grouse were collected on the study area and the remaining 26 percent were taken on or near the wintering grounds.

The grouse at Gorge Creek utilized 35 species of plants, and arthropods from 11 different families of insects plus spiders and myriapods. Most of the food was of vegetable origin. The leaves of the legumes Lathyrus ochroleucus and Vicia americana and the fruit of Ribes oxvanchoides and Arctostaphylos uva-ursi contribute the greatest volume of food in the spring, summer and early autumn. The members of the grasshopper family, Acrididae, are the only animal food that contributes any significant amount to the diet. Beer (1943) reported that the year-round diet of blue grouse is 98.3 percent of plant origin and only 1.7 percent of animal origin. He reported also that 67 percent of the bird's yearly diet is composed of conifer needles. Oddly enough the two dominant legumes in the diet of Richardson's grouse at Gorge Creek are not mentioned in Beer's paper.



Table X Analysis of contents of 38 Richardson's grouse crops of which 4 were collected in May, 14 in June, 5 in July, 1 in August, and 14 in September of 1955-57 inclusive

Plant Material	Species	Number of crops containing food items	Average volume of each item per crop (%)
Pinacéae			
<u>Larix lyalli</u> Parl.	needles (2)	1	88
<u>Picea glauca</u> (Moench) Voss	needles (2)	2	40
<u>Pinus contorta</u> Dougl.	needles (2,5)	5	7
Gramineae	leaves (1,2,5)	5	trace
Salicaceae			
<u>Populus tremuloides</u> Michx.	leaves (2)	4	51
<u>Salix</u> sp.	leaves (1,2,5)	4	12



Table X - cont'd

Species	Number of crops containing food items	Average volume of each item per crop (%)
Polygonaceae		
<u>Polygonum viviparum</u> L. fruit (5)	6	2
<u>Polygonum</u> sp. fruit (3)	1	trace
Ranunculaceae		
<u>Anemone canadensis</u> L. fruit (2)	2	4
<u>Anemone</u> sp. leaves (1)	1	60
<u>Pulsatilla ludoviciana</u> (Nutt.) Heller leaves (3)	1	trace
Saxifragaceae		
<u>Ribes oxycanthoides</u> (L.) Mill. leaves (1)	1	21
<u>R. oxycanthoides</u> fruit (2,3,4,5)	8	78



Table X - cont'd.

Species	Number of crops containing food items	Average volume of each item per crop (%)
Rosaceae		
<u>Fragaria glauca</u> (S. Wats.) Rydb. fruit (1,3)	2	4
<u>Spirea lucida</u> Dougl. leaves (2)	1	58
<u>Rosa</u> sp. flowers (1)	1	5
<u>Dryas octopetala</u> L. leaves (5)	1	trace
Leguminosae		
<u>Vicia americana</u> Muhl. leaves (2,3,4,5)	9	14
<u>Lathyrus ochroleucus</u> Hook. leaves (2,3,4,5)	17	42
<u>Hedysarum sulfurescens</u> Rydb. leaves (5)	4	74
<u>H. sulfurescens</u> fruit (5)	4	13



Table X - cont'd

Species	Number of crops containing food items	Average volume of each item per crop (%)
Geraniaceae		
<u>Geranium</u> sp. leaves (1)	1	5
<u>Geranium</u> sp. fruit (3)	1	trace
Elaeagnaceae		
<u>Shepherdia canadensis</u> (L.) Nutt. fruit (2,3)	5	31
Umbelliferae		
<u>Leptotaenia multifida</u> Nutt. leaves (1)	1	5
Ericaceae		
<u>Arctostaphylos uva-ursi</u> (L.) Spreng. fruit (2,3,5)	7	30
Vacciniaceae		
<u>Vaccinium scoparium</u> Leiberg. fruit (5)	2	36



Table X - cont'd

Species	Number of crops containing food items	Average volume of each item per crop (%)
Primulaceae		
<u>Dodecatheon cusicki</u> Greene leaves (1)	1	16
<u>Dodecatheon</u> sp. fruit (3)	1	trace
Scrophulariaceae		
<u>Pentstemon nitidus</u> Dougl. fruit (3)	1	5
Rubiaceae		
<u>Galium boreale</u> L. leaves (1,2)	3	16
Companulaceae		
<u>Companula rotundifolia</u> L. flowers (3,5)	4	24
Compositae		
<u>Agoseris glauca</u> (Pursh) Raf. leaves (1,5)	2	6



Table X - cont'd

Species	Number of crops containing food items	Average volume of each item per crop (%)
<u>Agoseris glauca</u> flowers (2,3)	2	23
<u>Taraxacum officinale</u> Weber leaves (1,2)	2	52
<u>Taraxacum</u> <u>o.</u> flowers (3,5)	2	10
<u>Achillea lanulosa</u> Nutt. leaves (1,5)	2	6
<u>Antennaria</u> sp. leaves (5)	2	41
Animal Material		
Orthoptera		
Acrididae (3,5)	5	36
Hemiptera		
Coreidae (5)	1	trace
Pentatomidae (5)	1	trace
Cicadellidae (1)	1	trace



Table X - cont'd

Species	Number of crops containing food items	Average volume of each item per crop (%)
Hymenoptera		
Formicidae (1,2,3,5)	11	8
Coleoptera		
Carabidae (2)	1	trace
Elateridae (3)	1	trace
Chrysomellidae (1)	1	trace
Curculionidae (3)	1	trace
Lepidoptera		
Geometridae (2,5)	3	12
Diptera		
Bibionidae (3,5)	2	trace
Arachnida (5)	1	trace
Myriapoda (5)	1	trace

Legend ( ) 1-May, 2-June, 3-July, 4-August, 5-September



Grit seems an important requirement in the diet. Gritty material was found in 45 out of a total of 51 (88 percent) of the stomachs examined; it was in the form of small quartz chips. The seeds of the fruit of Arctostaphylos uva-ursi also assumed an important role as grit. They were found in 82 percent of the stomachs. Altogether, grit and seeds made up an average of 40 percent of the volume of all stomach contents.

The diet of the juvenile grouse was determined from the analysis of the contents of 38 crops. Seventy-nine percent of birds sampled were taken from the study area, the remaining 21 percent were from the wintering grounds or near by. These juvenile birds varied from two to ten weeks in age. The analyses are presented in Table XI.

The proportion of animal matter in the diet of juvenile birds was somewhat greater than in that of the adults, especially during July. Species from 23 families of arthropods and one species of mollusc were taken by the young grouse. As in the diet of the adult birds, the members of the grasshopper family Acrididae were the only arthropods that were significant contributors to the diet. It is of interest to note that one bird made a meal of the small land snail Vitrina alaskana.



juvenile

Table XI Analysis of contents of 38 Richardson's Grouse crops of which 3 were collected July, 7 in August, and 28 in September of 1955-57 inclusive.

Plant Material	Species	Number of crops containing food items	Average volume of each item per crop (%)
Pinaceae			
	<u>Pinus contorta</u> Dougl. needles (5)	4	9
Gramineae	leaves (5)	7	trace
Salicaceae			
	<u>Salix</u> sp. leaves (5)	2	33
Polygonaceae			
	<u>Polygonum viviparum</u> L. fruit (5)	7	2
	<u>Polygonum</u> sp. fruit (4)	1	2
Saxifragaceae			
	<u>Ribes oxycanthoides</u> (L.) Mill. fruit (3,4,5)	20	66



Table XI - cont'd

Species	Number of crops containing food items	Average volume of each item per crop (%)
Rosaceae		
<u>Rubus strigosus</u> Michx. fruit (4,5)	5	15
<u>Fragaria glauca</u> (S. Wats.) Rydb. fruit (3,4,5)	7	15
<u>Dryas octopetala</u> L. leaves (5)	1	trace
Leguminosae		
<u>Vicia americana</u> Muhl. leaves (3,4,5)	10	10
<u>Lathyrus ochroleucus</u> Hook. leaves (5)	6	4
<u>Hedysarum sulfurescens</u> Rydb. leaves (5)	5	87
<u>Trifolium</u> sp. leaves (5)	3	6
Ericaceae		
<u>Arctostaphylos uva-ursi</u> Leiberg fruit (5)	3	59



Table XI - cont'd

Species	Number of crops containing food items	Average volume of each item per crop (%)
Caprifoliaceae		
<u>Symphoricarpos occidentalis</u> Hook. fruit (5)	1	9
Companulaceae		
<u>Companula rotundifolia</u> L. flowers (5)	1	12
Compositae		
<u>Taraxacum officinale</u> Weber leaves (4,5)	4	9
<u>Antennaria</u> sp. leaves (5)	2	23
Animal Material		
Mollusca		
<u>Vitrina alaskana</u> Dall. (4)	1	75
Orthoptera		
Acrididae (3,4,5)	25	39



Table XI - cont'd

Species	Number of crops containing food items	Average volume of each item per crop (%)
Hemiptera		
Coreidae (3,4,5)	3	trace
Miridae (3,4,5)	9	trace
Pentatomidae (5)	1	20
Cicadellidae (4,5)	5	trace
Corixidae (4)	1	trace
Cydnidae (4)	1	trace
Membracidae (4,5)	3	trace
Aphididae (3)	1	trace
Scutelluridae (4)	1	3
Hymenoptera		
Ichneumonidae (4,5)	8	trace
Formicidae (3,4)	23	2



Table XI - cont'd

Species	Number of crops containing food items	Average volume of each item per crop (%)
<b>Coleoptera</b>		
Carabidae (4)	1	trace
Elatridae (4)	1	trace
Chrysomellidae (4,5)	8	trace
Curculionidae (3,4,5)	5	trace
Coccinellidae (4,5)	4	trace
<b>Lepidoptera</b>		
Geometridae (3,4,5)	10	5
Arctiidae (3)	1	trace
Noctuidae (4)	1	67
<b>Diptera</b>		
Tabanidae (3)	1	trace
Muscidae (4,5)	2	trace
Arachnida (4,5)	9	trace



Eighteen species of plants were utilized. The fruit of Ribes oxycanthoides and Fragaria glauca plus the leaves of Vicia americana contributed the most to the vegetable diet of the young grouse.

The young grouse seem to depend more on the hard seeds of fruit that they eat for their grit than they do on mineral matter. Seeds of Arctostaphylos uva-ursi alone made up 23 percent of stomach volumes while mineral grit made up only 16 percent. The two forms of grit appeared in the stomachs with a frequency of 60 and 98 percent, respectively.

The volume of food in the crops varied according to the time of day that the grouse were collected. The greatest volume was found in the crops of birds taken in the evening after the peak feeding period at 7:30 p.m.. At this time a single crop may contain as much as 73ml. of food materials. The average volume of the contents of 76 crops of grouse taken throughout the day was 15 ml..

The feeding habits of the grouse vary somewhat with time of year and weather conditions. During the winter the birds remain in the thickly branched conifers near timberline. Here they eat the tips of pine needles (mostly young needles of the previous summer's growth). That they remain in the trees is shown by the fact that scat, which contained



only pine needle remains, is evenly distributed below the trees in which they have spent some time. In spring the grouse migrate back to the breeding grounds where they feed heavily on the new green shoots which have appeared on the snow-free slopes. If a spring snow should come and cover the slopes as happened from May 13 to 16, 1955, the grouse take refuge in the conifers on the breeding grounds and return to their diet of needles.

During the summer and fall the grouse exhibit definite peaks of feeding activity. Beer (1943) stated the peak feeding time in the morning occurs from 7:00 to 9:00 a.m.. The birds then rest for an hour and feed again from 10:00 until 11:00 a.m., after which they will rest until about 2:00 p.m.. From 2:00 p.m. until 5 :00 p.m. the birds pick up a little food but the evening peak of feeding is not reached until 7:30 p.m.. Beer's classification of activity periods coincides well with the observations at Gorge Creek.



### VIII Range Requirements

Richardson's grouse require a considerably greater range than do most other species of indigenous grouse. This is due to the extensive yearly cruising radius which, in the Gorge Creek area, amounts to at least eight miles. While on the wintering grounds the birds are very sedentary, and it is assumed that they spend most if not all the winter in a single clump of conifers. They are also quite confined during the breeding season; the males remain on their individual territories and the females and broods remain on their somewhat larger home ranges. The immature birds move at random through these areas and have a somewhat greater summer cruising radius than either the adult males or females. However, at the end of the breeding season the area between breeding grounds and wintering grounds is traversed. At this time birds may be found widely scattered over this transition area.

Richardson's grouse inhabit elevations of 4600 to 7500 feet above sea level in the Gorge Creek area. The greatest concentration of wintering birds is found at timberline, an elevation there of 7000 feet. The greatest concentration of breeding birds is at about 5000 feet. The birds are not confined by the food species on which they are dependent,



because the dominant species in their diet are widespread and common throughout their entire range. As mentioned in a preceding section the blue grouse is confined to the open and semi-open hillsides where it enjoys the cover of mixed stands of pine, fir and poplar, interspersed with grassy areas. It gives way to ruffed grouse in the thickly wooded bottomlands and to Franklin's grouse in the heavy stands of second growth pine. Where Richardson's grouse overlaps with either of these two species there seems to be complete interspecific tolerance. On August 17, 1957, a female and brood were flushed along with an adult ruffed grouse from a raspberry patch. On July 3, 1957, a female blue grouse and brood were found in close proximity to a female ruffed grouse and brood. Neither female showed any aggressiveness and each brood went its own way. The two essentials for the range of Richardson's grouse seem to be adequate slopes (mountainous terrain) and open to semi-open tree cover.



## IX Parasites And Disease

Bendell (1955) maintains that parasites form one of the major controlling factors in a population of sooty grouse on Vancouver Island. He states that two-thirds of the chicks are lost through the ravages of a nematode Dispharynx nasuta Rud. and an acanthocephalan, Plagiorhynchus formosus Van Cleave. Examination of the gastro-intestinal tracts from 42 birds one year and older and 32 juveniles disclosed but one infestation of a nematode. This roundworm was discovered in the proventriculus of an adult male grouse. Beer (1944), in a paper on the parasites of blue grouse, states that cestodes are common to this species. Raillientinia sp., he found infecting 13.7 percent of all birds and Rhabdometra nullicollis Ransom, 43.5 percent. Richardson's grouse taken at Gorge Creek also proved to be quite heavily infected with tapeworms. Sixty-four percent of 42 immature and adult birds were infected, and 71 percent of 32 juveniles. The infection varied from one or two worms to an almost virtual blockage of the gut tract. Most of the worms were found in the ileum. The species found infecting Richardson's grouse at Gorge Creek were identified by Dr. R. B. Miller of the Department of Zoology, University of Alberta, as Raillientinia sp.,



Rhabdometra odiosa (Leidy) and Davainea proglottina (Davaine).

Emerson (1951) has presented a list of Mallophaga from Richardson's grouse. Two species of feather lice occur, namely Goniodes merriamianus Packard and Lagopoecus obscurus Emerson. Both species were taken from adult and juvenile grouse collected at Gorge Creek.

The incidence of disease is unknown. Only one bird was found dead during the three summers study. This bird was an adult male and was picked up shortly after it had died. Dr. C. H. Bigland of the Veterinary Laboratory of the Alberta Department of Agriculture reported lesions found on the lungs, air sacs and kidney were caused by a mycotic condition, probably due to Aspergillus fumigatus. It is presumed that this was the lethal agent.

The incidence of cestode infection and Mallophagan infestation is high in Richardson's grouse from southwestern Alberta but the incidence of nematode infection and disease appears to be low. The overall effect of these agents on the mortality in this population is unknown but is presumed to be negligible.



## X Sex Ratios, Age Composition And Mortality

The difference in cervical feathers has proved an effective and rapid method of sexing Richardson's grouse, two months of age and older, (Caswell, 1954). The cervical feathers of the male grouse show white bases whereas those of the female are gray-brown for their entire length. The sex ratio in juvenile Richardson's grouse was determined through the examination of 77 sexable young birds and gave the following results: 57 percent female and 43 percent male. These percentages are not significantly different from the theoretical 50:50 ratio. On the other hand, the sex ratio in immature grouse on the breeding grounds was 69 percent females to 31 percent males (out of 32 birds), which shows a significant difference at the five percent level by a chi-square test. The sex ratio of adults is based on the numbers of males and females caught and marked on the study area over the three seasons. Of the 75 birds that were handled, 35 percent were males and 65 percent were females. This ratio is not significantly different from that of the immature ratio. Therefore after the birds are one year old, the sex ratio remains relatively constant at a 2:1 ratio in favor of the females.

The age composition was determined from



110 immature and adult birds caught and marked on the study area. Immature birds made up 30 percent and adults 70 percent of the population.

The annual mortality rate may be estimated from the returns of banded birds. Only 25 percent of birds banded as juveniles were found the next year (as yearling birds); this indicates a 75 percent mortality, or loss through dispersal, over the first winter; 50 percent of the birds banded as yearlings were re-taken the following years as two-year-olds, indicating a 50 percent mortality (or other loss) during the second winter; the returns of banded adults were complete, indicating no apparent mortality after the second winter.

By using the mortality rates derived in the preceding paragraph plus the data on sex ratios and age composition, Table XII has been constructed.

Mortality is accomplished through a number of agencies; the most obvious are parasites and disease, adverse weather, predation, accidents and possibly old age. As stated in the previous section, two-thirds of the chick population of sooty grouse are lost through the ravages of nematode and acanthocephalan parasites, (Bendell, 1955). However, there is no evidence that such losses occur at Gorge Creek.



Theoretical  
Table XII Population composition of Richardson's  
grouse at Gorge Creek

<u>Juveniles</u>	<u>Yearlings</u>	<u>2,</u>	<u>3,</u>	<u>4,</u>	<u>5,</u>	<u>Adults</u>		<u>8,</u>	<u>9 years</u>
100	25	12	12	12	12	6	3	1	0

<u>Age</u>	<u>Theoretical ratios</u>	<u>Observed ratios</u>
100 Juveniles	50♂♂:50♀♀	50:50
25 Yearlings	9♂♂:16♀♀	35:65
58 Adults	20♂♂:38♀♀	35:65
Yearling:Adult	25 : 58	30:70
Adult ♀♀: Juvenile	1 : 2.7	1:2.5-5.3



Table XIII is based on sight records of 267 broods and indicates the gradual decrease in brood numbers after the heavy initial loss.

Adverse weather conditions are believed to be a major controlling factor in the survival of the newly hatched Richardson's grouse in southwestern Alberta. It has been noted that the downy chicks succumb easily when exposed to wet and cold conditions. The percentage survival of the downy young can be correlated directly with the rainfall during the first two weeks of the chick's life. Table XIV is a record of weather conditions during the first two weeks after the date of hatching in 1955, 1956, and 1957.

Table XIV    Number of days on which heavy rains fell during first two weeks of chicks' lives in 1955, 1956, and 1957.

<u>Year</u>	<u>Number of days on which rain fell</u>	<u>% of first 14 days</u>	<u>Average brood size at end of 14 days</u>
1955	8	57	4.8
1956	7	50	3.9
1957	2	14	5.7



Table XIII Record of broods sighted and  
number of chicks per brood.

<u>Weeks</u>	<u>1955</u>		<u>1956</u>		<u>1957</u>	
	Broods sighted	Average No. chicks/brood	Broods sighted	Average No. chicks/brood	Broods sighted	Average No. chicks/brood
June 24-30	-	-	-	-	10	2.7
July 1-7	-	-	8	2.2	6	5.7
July 8-14	-	-	10	3.9	8	3.9
July 15-21	6	2.6	9	3.3	4	3.5
July 22-28	5	4.8	9	3.6	5	5.0
July 29-4	12	4.1	8	3.2	15	3.7
Aug. 5-11	2	4.5	9	3.1	12	4.3
Aug. 12-18	10	3.4	11	2.9	18	3.7
Aug. 19-25	7	3.1	11	3.2	10	5.9
Aug. 26-1	14	2.7	8	2.8	11	5.3
Sept. 2-8	5	3.2	11	2.5	-	-
Sept. 9-15	12	2.6	1	2.0	-	-



With a week of rainy days during the first two weeks of the chick's life, the average brood of seven suffered a loss of two or three chicks; however, with only two rainy days out of the first fourteen the average brood lost only one chick. Table XIV indicates an over-summer mortality, after the first two weeks, accounted, on the average, for one more chick - probably through predation.

Predation is an active agent that is always at work in a natural population. Raay (1926) stated that the scarcity of blue grouse in 1924 in the Alta Lake region of British Columbia could be "accounted for by the very large increase in the numbers of horned owls". Only one case of horned owl predation on Richardson's grouse was noted during the three summers study at Gorge Creek; but as this owl was quite common on the study area it is reasonable to assume that it is one of the major predators. In 1955, the author studied the food habits of a pair of golden eagles whose nest was situated on the study area; 13 percent of the total number of animals brought to the nest were Richardson's grouse. This percentage represented ten adult or yearling grouse. Other probable avian predators that were observed on the study area, but for which there was no direct evidence of predation, include Cooper's hawk, the goshawk and four species of



corvids, the last being nest predators only. Coyotes also prey on this grouse. Blue grouse remains were found at a coyote den on May 28, 1955. Mammalian predators observed on the study area besides the coyote include lynx and weasel. These are both scarce and the effect of their predation is believed to be insignificant. No evidence of mortality from accidents and old age was obtained in the study at Gorge Creek. Accidents among grouse are presumed rare enough to be insignificant and little is known about the longevity. Adult birds banded at Gorge Creek in 1955 were, at a minimum, four years old in 1957. Table VIII indicates that survival past one year of age is high; the percentage return of banded adult males and females is the same after two years as it is after one year. However, male grouse banded as yearlings and as juveniles show a very poor return. Observations on the study area suggest that yearling males are not tolerated on the territories of adult males and are continually being harrassed and forced into less favorable cover where they fall prey to predators. This would account for the greater number of returns of female grouse banded as yearlings, since the immature females are tolerated and are often the recipients of most of the courtship displays.

Too few juvenile birds were banded in 1955 and 1956 to justify any firm conclusions.



However, it would appear that there is a wide dispersal of juveniles from the breeding grounds; the collecting of a juvenile female 27 miles north of the breeding grounds has been mentioned previously.

The population equilibrium shown in Table XII could be accomplished, therefore, through adverse weather and predation reducing broods to an average of 2.7 chicks per adult female. Dispersal and predation could account for 75 percent of the surviving chicks failing to return to the breeding grounds. Predation could account for 50 percent of the yearlings that fail to return to the breeding grounds in their second year. Disease and predation could account for the loss of birds after they are five years of age.



## XI Management

### 1. Hunting Regulations

It is difficult to determine the proper hunting season for Richardson's grouse. Because of the bird's slow growth rate, hunting prior to the first of September is not practical as the young grouse (which form the major part of the hunter's bag) are neither fully feathered nor have they reached their full immature weight. However, if the hunting season is delayed until the middle of September, most of the grouse have left the easily accessible breeding grounds and are unavailable to the majority of hunters who will not pursue them as high as the wintering grounds. In Idaho it has been found that September hunting based on August brood counts is the most satisfactory. Here, the brood counts along water courses, in August, furnish a dependable estimate of yearly population trends, (Marshall, 1946). Table XIII shows that the maximum number of broods were seen on the study area at Gorge Creek during August, so that brood counts at this time would also give reliable estimates of yearly population trends on which to base a September hunting season. However, such a season in Alberta has another disadvantage besides the two quoted above. Since the open season on blue grouse in Alberta is not coincident



with the ruffed and Franklin's grouse season a great many of the latter are taken illegally by hunters who fail to distinguish the species.

There is a distinct possibility that a spring season during June would be more practical in providing a maximum harvest of birds without injuring the brood stock. Table XV gives the numbers of grouse of each sex flushed over the period June 7 to June 21

Table XV Grouse flushed on the study area  
from June 7 to June 21.

<u>Year</u>	<u>Number of males</u>	<u>%</u>	<u>Number of females</u>	<u>%</u>
1955	41	79	11	21
1956	47	76	15	24
1957	23	74	8	26

The vast majority of the flushed females were non-breeding immature birds. At this time adult females would be incubating and hence would be relatively invulnerable to hunters and their dogs. The advantages of a season from June 7 to 21 would be fourfold. The harvest would consist of 75 percent adult and immature males and 25 percent immature females. These birds are largely lost to the hunter under the existing regulations; the September shoot takes mostly adult females and juveniles. A June season would give the juveniles a chance to mature and return to the



breeding grounds where they would be available to the hunter. Since this species is promiscuous in breeding habits a reduced male to female ratio is less likely to interfere with reproduction. The elimination of some adult males would allow a higher survival of yearling males as fewer would be driven out of the area by the adult males. Birds harvested in June would be fully grown, in good condition and highly palatable, altogether, of superior quality to birds shot in September. The problem of identification of species would be minimized as adult blue grouse are much more easily distinguished from ruffed and Franklin's grouse than are juvenile blue grouse.

## 2. Predator Control

Predation was not considered a serious limiting factor in the population of grouse in the Gorge Creek area. This fact may be due to buffer species such as the Columbian ground squirrels (Citellus columbianus (Ord)) which were present in good numbers on the study area. It is felt that if the blue grouse population were to fall significantly the predation pressure would also fall and predators would prey more heavily on small mammals. Therefore, with predators at present densities, there is no need for predator control in the Gorge Creek area.



### 3. Refuges

The value of refuges in game management depends on the biology of the species in question. It must possess a high reproductive rate and must show a high mobility. Blue grouse fail to meet the first requirement but do show a fairly high mobility. However, because of their migratory habits, the refuge would have to be of considerable size to be of any value; it would have to encompass a good breeding and wintering range. Alberta has three National Parks on its western boundary which would act as a reservoir for blue grouse if the east slopes were ever hunted heavily enough to seriously diminish their numbers. Such a hunting pressure is rather unlikely. Therefore, the development of refuges is believed to be of little value in managing the population of blue grouse on Alberta's east slopes.

### 4. Habitat Improvement

As has been seen, the distribution of blue grouse depends on an open type of forest. A climax closed forest is as unattractive to this species as unforested areas, a fact also true for other species of game. Today the greatest concentrations of Richardson's grouse in the Sheep River area are to be found



in areas that were burned during the fire of 1939. These areas have now grown up to stands of trembling aspen, lodgepole pine and mixed stands of conifer and deciduous trees. It is this mixed and open type of forest that affords the type of cover in which this grouse reaches its highest population densities. On Vancouver Island, logging operations have opened up the climax forests enough to provide good habitat for blue grouse. However, burned areas that have regained partial cover furnish the best habitat. Therefore, the improvement of habitat through strip or patch logging and through controlled burning of valueless timber would increase the habitat suitable for blue grouse.

##### 5. Public Relations Programme

Before a management programme may become effective in increasing the numbers of any species, it is essential that the hunting public be able to identify the species they plan to hunt. In Alberta there are very few upland game hunters who are able to recognize the blue grouse. This is partly due to confusion over local names, such as 'fool hen' which is applied to the above species as well as to the ruffed grouse and Franklin's grouse. It is also convenient to be ignorant if the hunter is out for meat alone. The above situations were exemplified on the opening day of the blue grouse



season in September, 1957. A sign was posted on the gates at the boundary of the Eastern Rockies Forest Conservation Area requesting that all grouse hunters check in at the Biological Station with the birds that they had shot. Thirteen hunters responded to the request; they reported thirteen birds in all. One out of the thirteen was a blue grouse, the others were all ruffed grouse. The chief reason given was ignorance of the birds identity. The same situation was observed in 1956 when hunters reported in with as many ruffed and Franklin's grouse as blue grouse. Since the open season for the former two species is not until the middle of October, the hunters' bags were illegal. Therefore, the hunting public should be taught to identify the game they hunt.

Checking stations through which the hunters must pass can yield valuable information as to the size and age composition of the kill as well as information on population trends. However, before any effective results are gained, the hunting public must be familiar with the objectives of the checks, and sympathetic to management studies.



## XII Conclusions

1. The blue grouse inhabiting the east slopes of the Rocky Mountains in Alberta is Richardson's grouse, Dendragapus obscurus richardsonii (Douglas).

2. Male Richardson's grouse are large dark-colored grouse. Females resemble males but are paler in color and show mottling. Both sexes possess a comb but only the male has a distensible gular patch. Molt patterns follow the usual course. Adult males average 43 ounces in weight, adult females, 33 ounces.

3. Richardson's grouse is confined to the mountains and foothills in Alberta. The birds prefer semi-open tree cover on hillsides; this interspersion of vegetative types determines their range. The density of one-year-old and older birds is one per 8.3 acres.

4. Richardson's grouse has pronounced seasonal movements between summer breeding grounds and winter range. Adults and yearlings arrive on the breeding grounds in April. Adult males are territorial; adult females inhabit a home range. Males and females return to their same territories and ranges on succeeding years. Territory and range depend on semi-open cover. Male grouse perform an elaborate display and mate with any receptive female that wanders into their territories. Females nest near the end of May and lay an average clutch of seven eggs. Hatching occurs about the end of



June. Newly hatched chicks stay close to the mother and keep to the open grassy slopes. As they mature they resort to the treed areas. There appears to be no shuffling of chicks between broods. Each brood remains on its own home range. The chicks accompany the adult female off the breeding grounds.

5. Richardson's grouse is slow in attaining maturity. Full adult weight is reached at the end of the bird's second summer. Males and females begin breeding when two years old. Adult females lose one-third of their body weight while incubating.

6. Adult Richardson's grouse depend largely on plant material for their summer diet. Juveniles utilize relatively greater amounts of animal material. Grit is an important requirement in the diet of this bird.

7. Richardson's grouse suffers a high incidence of cestode infection and mallophagan infestation but a low incidence of nematode infection and disease.

8. Adverse weather and predation are two limiting factors which determine the population equilibrium numbers.

9. Education of the hunting public and habitat improvement are two management techniques which could improve hunting of Richardson's grouse in Alberta.



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XV Appendix

Table XVI Population estimate of grouse  
on study area, 1955.

<u>Date</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>AB</u>	<u><math>\Sigma AB</math></u>	<u><math>\Sigma C</math></u>	<u>P</u>
May 11	8	2	0	16	16	0	-
May 12	4	2	1	8	24	1	24
May 14	1	2	0	2	26	1	26
May 17	1	2	1	2	28	2	14
May 18	9	2	1	18	46	3	15
May 19	1	5	0	5	51	3	17
May 20	15	5	0	75	126	3	42
May 22	27	5	0	135	261	3	87
May 25	18	5	1	90	351	4	88
May 26	1	8	1	8	359	5	72
May 27	20	8	0	160	519	5	104
May 28	10	8	0	80	599	5	120
May 29	1	11	0	11	610	5	122
May 30	2	11	0	22	632	5	126
May 31	10	11	1	110	742	6	124
June 1	12	13	2	168	910	8	113
June 2	6	15	3	90	1000	11	91
June 3	3	16	1	48	1048	12	87
June 4	7	16	2	112	1160	14	83
June 6	17	16	3	372	1432	17	84
June 7	9	17	0	153	1585	17	93



Table XVI - cont'd.

<u>Date</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>AB</u>	<u>ΣAB</u>	<u>ΣC</u>	<u>P</u>
June 8	5	17	0	85	1670	17	98
June 9	2	17	0	34	1704	17	100
June 10	7	17	2	119	1823	19	96
June 11	1	17	0	17	1840	19	97
June 12	12	17	1	204	2044	20	102
June 13	4	17	0	68	2112	20	106
June 14	11	17	0	187	2299	20	115
June 15	3	17	1	51	2350	21	112
June 16	1	17	0	17	2367	21	112
June 17	3	17	0	51	2418	21	115
June 18	6	17	0	102	2520	21	120
June 19	5	17	1	85	2605	22	118
June 20	1	20	0	20	2625	22	119
June 21	2	20	0	40	2665	22	121
June 22	1	20	0	20	2685	22	122
June 23	6	20	2	120	2805	24	117
June 24	1	20	1	20	2825	25	113
June 25	9	20	0	180	3005	25	120



Table XVII Population estimate of grouse  
on the study area, 1956.

<u>Date</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>AB</u>	<u>ΣAB</u>	<u>ΣC</u>	<u>P</u>
May 9	8	7	0	56	56	0	-
May 11	11	8	0	88	144	0	-
May 12	6	8	0	48	192	0	-
May 13	10	10	0	100	292	0	-
May 14	17	10	4	170	462	4	116
May 15	5	12	1	60	522	5	104
May 16	3	12	1	36	558	6	93
May 17	6	12	2	72	630	8	79
May 18	1	13	1	13	643	9	71
May 19	10	13	4	130	773	13	59
May 20	6	14	2	84	857	15	57
May 21	6	15	2	90	947	17	56
May 22	5	15	2	75	1022	18	57
May 23	11	15	2	165	1187	20	59
May 24	3	16	2	32	1219	22	55
May 25	14	18	4	252	1471	26	57
May 26	1	19	0	19	1490	26	57
May 28	3	19	0	57	1547	26	60
May 29	6	19	2	114	1661	28	59
May 31	3	19	2	57	1718	30	59
June 1	4	20	0	80	1798	30	60
June 2	3	22	1	66	1864	31	60



Table XVII - cont'd

<u>Date</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>AB</u>	<u><math>\Sigma AB</math></u>	<u><math>\Sigma C</math></u>	<u>P</u>
June 8	5	22	1	110	1974	32	62
June 9	4	22	0	88	2062	32	64
June 10	9	22	3	198	2250	35	64
June 11	5	22	0	110	2360	35	67
June 12	5	24	2	120	2480	37	67
June 13	10	24	1	240	2720	38	72
June 14	1	24	0	24	2744	38	72
June 17	11	25	1	275	3019	39	77
June 18	1	25	0	25	3044	39	78
June 19	11	25	3	275	3129	42	75
June 21	18	25	3	450	3579	45	80
June 23	2	25	0	50	3629	45	81
June 24	4	25	2	100	3729	47	79
June 25	5	25	1	125	3854	48	80
June 26	2	25	0	50	3904	48	81
June 27	3	25	0	75	3979	48	83
June 30	17	25	3	425	4004	51	79



Table XVIII Population estimate of grouse  
on the study area, 1957.

<u>Date</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>AB</u>	<u>Σ AB</u>	<u>Σ C</u>	<u>P</u>
May 14	14	26	5	364	364	5	73
May 15	10	27	3	270	630	8	79
May 16	8	27	6	216	846	14	60
May 17	10	27	3	270	1116	17	66
May 18	19	28	5	532	1648	22	75
May 19	7	30	5	210	1858	27	69
May 20	8	30	2	240	2098	29	72
May 21	1	30	1	30	2128	30	70
May 22	14	30	3	420	2548	33	77
May 23	16	30	7	480	3028	40	76
May 24	5	30	3	150	3178	43	74
May 27	14	30	4	420	3598	47	77
May 28	5	30	4	150	3748	51	73
June 6	8	30	4	240	3988	55	73
June 9	1	30	0	30	4018	55	73
June 10	2	30	0	60	4078	55	74
June 11	8	30	4	240	4318	59	73
June 12	3	28	1	84	4402	60	73
June 14	4	27	1	108	4510	61	74
June 16	3	26	1	78	4588	62	74
June 17	5	26	2	130	4718	64	74
June 19	3	24	2	72	4790	66	73



Table XVIII - cont'd

<u>Date</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>AB</u>	<u><math>\Sigma AB</math></u>	<u><math>\Sigma C</math></u>	<u>P</u>
June 22	2	23	1	46	4836	67	72
June 23	5	23	1	115	4851	68	73
June 24	6	24	3	144	5095	71	72
June 25	5	25	1	125	5220	72	73
June 26	3	25	2	75	5295	74	72
June 27	3	25	0	75	5370	74	73
June 28	5	25	2	125	5495	76	72
June 29	4	25	1	100	5595	77	73



Table XIX Sex and weight of juvenile Richardson's

grouse taken at Gorge Creek.

1955			1956			1957		
Date	Sex	Weight (oz.)	Date	Sex	Weight (oz.)	Date	Sex	Weight (oz.)
July 6	-	1	June 30	-	1	June 22	-	3/4
Aug. 2	♀	6	June 30	-	1	June 26	-	1
Aug. 4	♂	4	July 2	-	1	June 28	-	1
Aug. 27	♀	14	July 5	-	1	July 7	-	5 1/2
Aug. 27	♀	21	July 18	-	3	July 18	♂	7
Aug. 28	♂	22	July 25	♀	6 1/2	July 18	♀	7
Aug. 31	♂	25	Aug. 1	♂	8	Aug. 5	♂	21
Sept. 8	♀	25	Aug. 1	♀	7	Aug. 6	♂	19
Sept. 8	♀	24	Aug. 8	♂	9	Aug. 8	♀	17
Sept. 9	♀	21	Aug. 18	♂	17 1/2	Aug. 11	♂	16
Sept. 10	♂	28 1/2	Aug. 18	♀	16 1/2	Aug. 12	♀	17
Sept. 10	♀	24 1/2	Aug. 20	♀	19	Aug. 13	♂	25
Sept. 11	♀	16	Aug. 22	♂	21 1/2	Aug. 13	♂	26 1/2
Sept. 11	♂	21	Aug. 25	♂	23	Aug. 13	♀	22



Table XIX - cont'd

1955			1956			1957		
<u>Date</u>	<u>Sex</u>	<u>Weight (oz.)</u>	<u>Date</u>	<u>Sex</u>	<u>Weight (oz.)</u>	<u>Date</u>	<u>Sex</u>	<u>Weight (oz.)</u>
Sept. 11	♂	29	Aug. 26	♂	20	Aug. 13	♀	21
Sept. 11	♀	24 1/2	Sept. 3	♀	23 1/2	Aug. 13	♂	21
Sept. 11	♀	23 1/2	Sept. 3	♀	25	Aug. 13	♀	17 1/2
Sept. 12	♂	29	Sept. 3	♂	30	Aug. 13	♂	21 1/2
Sept. 13	♀	21 1/2	Sept. 3	♂	31	Aug. 14	♂	27 1/2
Sept. 13	♀	23 1/2	Sept. 3	♂	27	Aug. 18	♀	18 1/2
Sept. 16	♂	21	Sept. 4	♀	23 1/2	Aug. 19	♀	17
			Sept. 4	♂	30 1/2	Aug. 19	♀	24
			Sept. 4	♀	24 1/2	Aug. 19	♀	23
			Sept. 4	♀	24 1/2	Aug. 23	♂	23
			Sept. 7	♂	25	Aug. 23	♀	25 1/2
			Sept. 16	♂	33	Aug. 24	♀	25 1/2
			Sept. 16	♂	33	Aug. 30	♀	25 1/2
			Sept. 16	♀	27	Aug. 30	♀	21 1/2
			Sept. 18	♂	37	Sept. 1	♂	32



Table XIX - cont'd

1955			1956			1957		
<u>Date</u>	<u>Sex</u>	<u>Weight (oz.)</u>	<u>Date</u>	<u>Sex</u>	<u>Weight (oz.)</u>	<u>Date</u>	<u>Sex</u>	<u>Weight (oz.)</u>
						Sept. 8	♀	24
						Sept. 8	♀	27
						Sept. 8	♂	29
						Sept. 8	♀	25 1/2
						Sept. 16	♀	30 1/2
						Sept. 16	♀	32



Table XX Sex and weight of immature Richardson's

grouse taken at Gorge Creek.

1955			1956			1957		
Date	Sex	Weight (oz.)	Date	Sex	Weight (oz.)	Date	Sex	Weight (oz.)
May 18	♀	26	May 17	♂	34	May 14	♂	34 1/2
May 25	♀	27 1/2	May 19	♂	30	May 17	♀	32 1/2
June 1	♂	31	May 21	♂	32	May 18	♀	37
June 2	♀	28 1/2	May 31	♀	29 1/2	June 11	♀	29
June 12	♀	31	June 1	♀	31	July 4	♀	26
June 19	♀	30	June 11	♀	29 1/2	July 8	♀	33 1/2
June 19	♀	29	June 11	♀	31 1/2	July 11	♀	31
June 19	♂	40	June 30	♂	38	July 14	♂	34
July 6	♂	37 1/2	July 7	♀	27 1/2	Aug. 12	♀	31
July 27	♂	39 1/2	July 30	♀	31	Aug. 12	♀	29 1/2
Sept. 13	♀	31	July 30	♀	32	Aug. 14	♀	31
			Sept. 16	♀	33	Aug. 19	♀	28 1/2
						Sept. 16	♀	35 1/2

1  
♀  
1



Table XXI Sex and weight of adult Richardson's  
grouse taken at Gorge Creek.

1955			1956			1957		
Date	Sex	Weight (oz.)	Date	Sex	Weight (oz.)	Date	Sex	Weight (oz.)
May 10	♀	31	May 9	♀	31 1/2	May 16	♀	36
May 10	♀	38	May 12	♂	49 1/2	May 17	♀	38 1/2
May 18	♀	31	May 12	♂	41	May 18	♂	43 1/2
May 18	♀	37	May 14	♂	40	May 21	♂	41 1/2
May 22	♀	38	May 14	♀	37 1/2	June 11	♂	39 1/2
May 25	♀	33 1/2	May 15	♂	40 1/2	June 11	♂	44
May 25	♂	40	May 17	♀	32 1/2	June 12	♂	42 1/2
May 28	♀	34	May 17	♀	34 1/2	June 14	♂	42 1/2
May 28	♂	42	May 18	♂	41	June 16	♂	45
May 28	♂	42 1/2	May 18	♀	34 1/2	June 16	♂	48
May 30	♂	40 1/2	May 20	♂	41	June 17	♂	43
May 31	♀	38	May 23	♂	43	June 17	♂	39
May 31	♀	35	May 24	♂	44	June 19	♂	47
June 1	♂	40 1/2	May 24	♀	42	June 22	♀	28



Table XXI - cont 'd

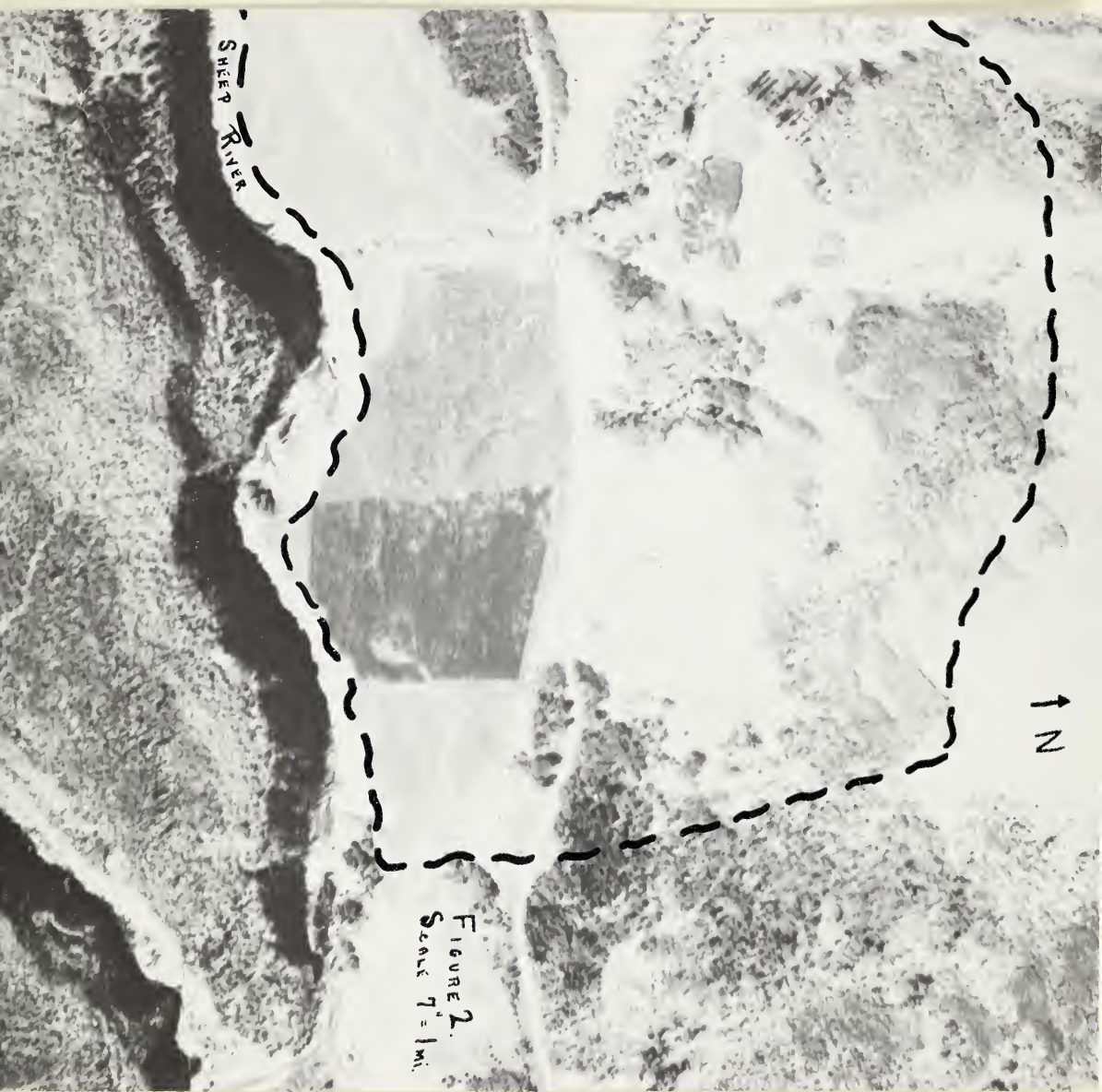
1955			1956			1957		
Date	Sex	Weight (oz.)	Date	Sex	Weight (oz.)	Date	Sex	Weight (oz.)
June 6	♀	38 1/2	May 25	♀	39	June 23	♀	30 1/2
June 12	♂	46 1/2	May 26	♀	43	June 23	♀	28
June 12	♀	34	May 26	♀	44	June 24	♀	29 1/2
June 17	♂	44	May 31	♀	44	June 25	♀	28 1/2
June 25	♂	38 1/2	June 6	♂	46	June 28	♀	26 1/2
June 25	♂	39	June 11	♂	42 1/2	July 6	♂	42
June 28	♀	32 1/2	June 13	♂	42	July 6	♀	28
July 16	♂	41 1/2	June 13	♂	45	July 6	♀	31
Aug. 28	♀	40	June 30	♂	49	July 18	♀	28 1/2
Sept. 13	♀	34	June 30	♀	30	Aug. 4	♀	27
			June 30	♀	30	Aug. 5	♀	32
			July 2	♀	28	Aug. 5	♂	46 1/2
			July 2	♀	29 1/2	Aug. 13	♀	33 1/2
			July 5	♀	28	Aug. 19	♀	31 1/2
			July 5	♂	42 1/2	Aug. 20	♀	31



Table XXI - cont'd

<u>1955</u>			<u>1956</u>			<u>1957</u>		
<u>Date</u>	<u>Sex</u>	<u>Weight (oz.)</u>	<u>Date</u>	<u>Sex</u>	<u>Weight (oz.)</u>	<u>Date</u>	<u>Sex</u>	<u>Weight (oz.)</u>
July 5	♀	31	July 5	♀	31	Aug. 23	♀	30 1/2
July 6	♂	47	July 6	♂	47	Aug. 29	♀	32 1/2
July 6	♀	33	July 6	♀	33	Aug. 30	♀	35 1/2
July 7	♂	41	July 7	♂	41	Sept. 4	♀	34
July 13	♀	28	July 13	♀	28	Sept. 7	♂	46
July 14	♀	26 1/2	July 14	♀	26 1/2	Sept. 16	♀	32
July 14	♀	28	July 14	♀	28	Sept. 16	♂	48
July 15	♀	26	July 15	♀	26	Sept. 18	♀	36
July 21	♀	28 1/2	July 21	♀	28 1/2			
July 23	♀	30 1/2	July 23	♀	30 1/2			
July 31	♀	28	July 31	♀	28			
Aug. 9	♀	29 1/2	Aug. 9	♀	29 1/2			
Sept. 3	♀	34	Sept. 3	♀	34			
Sept. 4	♀	34	Sept. 4	♀	34			
Sept. 7	♀	34	Sept. 7	♀	34			





SHEEP RIVER

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FIGURE 2.  
Scale 1" = 1 mi.





**B29776**